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(54) Abstract Title  
**Bulk material loading system**

(57) A bulk material loading system for filling a receptacle 1 with a bulk material 3, e.g. a crop, without damage to the material, comprises a chamber 5, which may have soft covered walls, transport means 9, e.g. an escalator, for loading the chamber, and moving means 25 for moving the chamber relative to both the transport means and the receptacle such that the distance between the chamber and receptacle floor can be reduced as the chamber fills with material. Preferably the chamber has a retractable floor 21, for unloading the bulk material into the receptacle when the chamber has moved sufficiently close to the receptacle floor, which is operated by a first belt 21 fixed at one side of the chamber and a roller 28 moveable across the bottom of the chamber. The chamber may also have a first side wall 7, adjacent to which the transport means are located, whose height may be varied by means of a second belt 11 fixed at one end to the base of the chamber and reeled in and out by a second drum 17. First 31 and second 37 remote sensors may be provided for detecting the amount of bulk material in the chamber and the distance from the chamber floor to the receptacle floor respectively and means may be provided for moving the chamber in a horizontal direction.

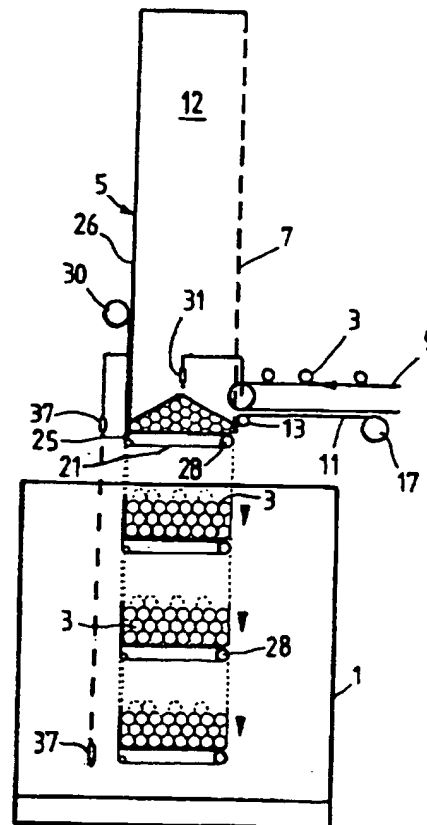
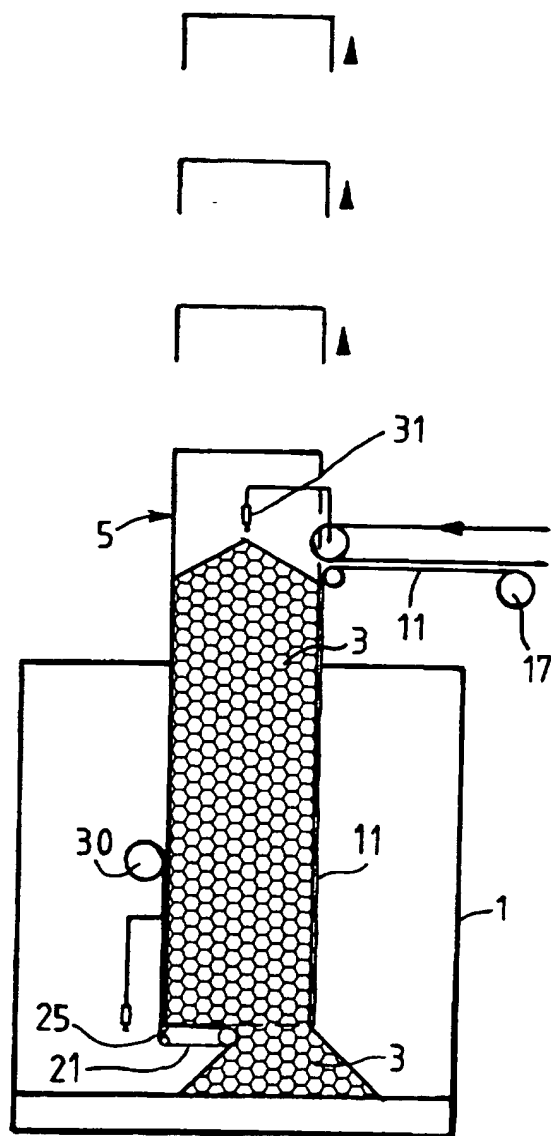
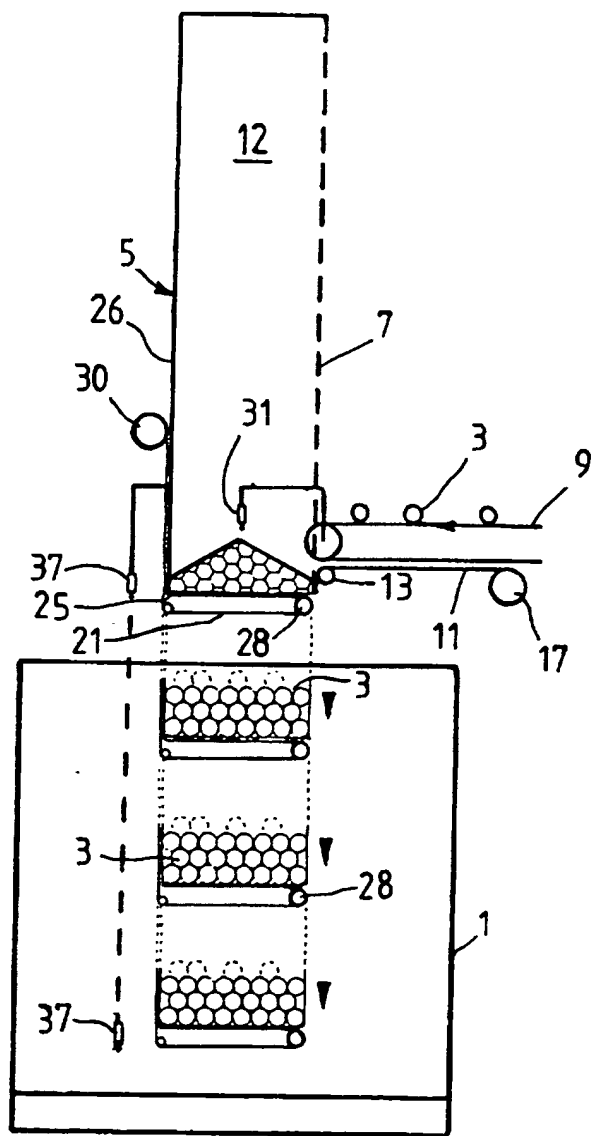


FIG. 1

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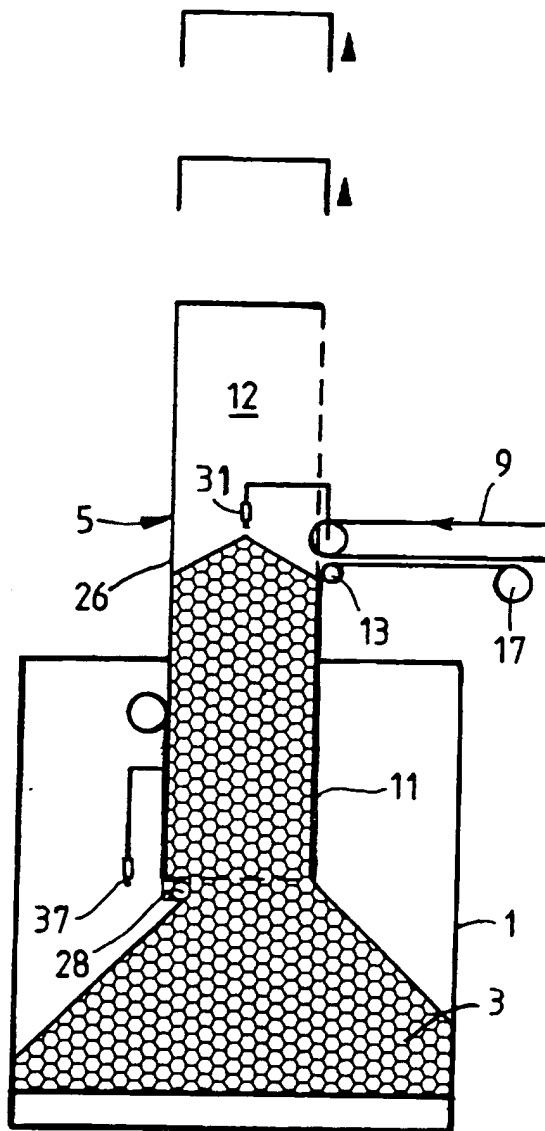


FIG. 3

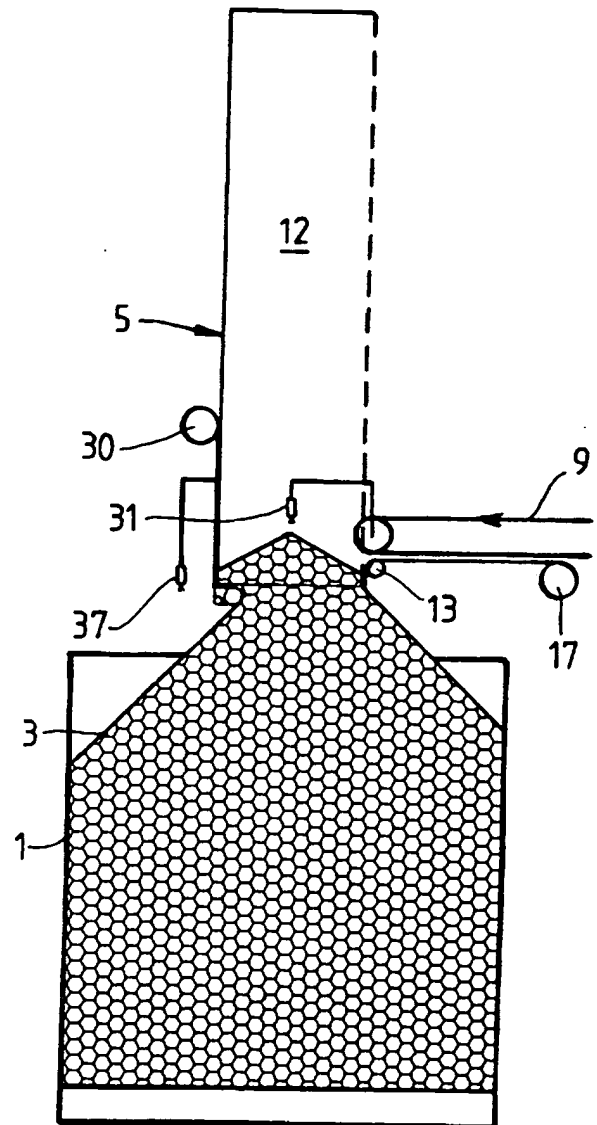


FIG. 4

### Filling System

The present invention relates to apparatus and a method for filling a receptacle with a bulk material. Specifically, the present invention is directed towards bulk materials such as potatoes, onions and other fruit and crops which suffer from bruising when decelerated rapidly.

Previously, the problem of how to fill deep boxes with easily damaged bulk materials, has led to the development of two types of box filler.

The first, and most common form of box filler tips the box onto its side, and fills by lowering the box progressively so that the crop never has a large drop, and subsequent high velocity. These fillers are now causing some safety concerns, because the box is automatically lowered. The box can weigh over a tonne and with some machines entrapment of feet and limbs is possible. These machines are also difficult to adapt quickly to different sizes of box.

The problems with the first type of box filler have led to a second type of box filler which does not tip the box. Here, a lowering conveyor with fingers or cleats will lower the crop to the bottom of the box. This conveyor progressively rises as the box fills. The safety drawbacks of the first type of filler are overcome because there are no entrapment points. Also, any size of box can be filled without adapting the machine. However, the drawback with these machines is that to reach commercially viable speeds of up to 1 tonne per minute, the conveyor belt speed has to be quite high. Therefore, the bulk product still emerges from the bottom of the conveyor at quite high

velocity. This causes exactly the same damage to the product as the box fillers as supposed to eliminate.

The present invention aims to overcome the problems related to delivering an easily damaged bulk material safely into a deep receptacle, filling the receptacle at a commercially viable speed and providing apparatus which is safe to use for the operator.

One aspect of the invention provides apparatus for filling a receptacle with a crop, the apparatus comprising a chamber which is vertically moveable into and out of the box, a conveyor belt for delivering the crop into the chamber, the crop being supported on the base of the chamber and the base of the chamber being lowered into the box and relative to the conveyor belt as the chamber fills with crop, and the base being retractable to release crop into the box from the bottom of the chamber.

In another aspect, the present invention provides a filling apparatus for filling a receptacle with a bulk product, the apparatus comprising a chamber for receiving the bulk product therein; transport means for transporting the bulk product to a base of the chamber; and moving means for effecting relative movement between said chamber with respect to both the receptacle and the transport means such that, as the chamber fills with the bulk product, the relative displacement between the chamber and a base of the receptacle is reduced.

It is preferable, if relative movement between the receptacle and the chamber is realised by keeping the receptacle stationary and lowering the chamber towards the base of the receptacle.

It will be appreciated by those skilled in the art that the bulk product can be continuously supplied to the chamber or the supply may be temporarily

stopped during motion of the apparatus varying the displacement between the chamber and the base of the receptacle.

The receptacle is filled by first loading the bulk product into the chamber. The chamber is in a raised position when the product is first loaded into it. As the level of the product rises in the chamber, the chamber itself is lowered. It is preferable if the chamber comprises a first side wall whose height is increased as the chamber is filled. The other walls of the chamber may be fixed. It is preferable if the internal walls of the chamber are soft covered to prevent damage to the product while in the chamber. In most situations, the chamber will have a square or rectangle cross section. However, it is apparent to those skilled in the art that other shapes of chamber may be used.

It is preferable if the first side wall is provided by a side belt which is fixed to the base of a chamber. As the chamber is lowered, the belt can be extended to increase the height of the first side wall. The belt can also be used to raise or lower the chamber itself. The other end of the belt can be fixed around a drum to roll the belt in or out, the weight of the chamber and crop keeping the belt tensioned. The belt runs around a guide to hold the vertical run of the belt against the edges of the adjacent chamber walls so that the belt is held in position against the chamber.

The apparatus further comprises transport means for filling the chamber. The transport means are preferably provided by a conveyor belt. The guide means for the side belt could be positioned so that the side belt forms the first side wall up to just below the conveyor belt.

Once the chamber is lowered, the bulk product is transferred to the receptacle. It is preferable if chamber further comprises an openable floor. It is more preferable if the openable floor does not scrape against the bulk

product when it is being opened as this might cause damage to the product. This can be realised by a retractable floor which comprises a retractable base belt which returns around a roller. It is preferable if this base belt is fixed to the bottom edge of a chamber wall, the roller being moved between the side and an opposing side of the chamber to close and open the base of the chamber. Other door arrangements could be used for the base of the chamber, for example a hinge door or clam shell door.

Once the floor is opened, the bulk product spills out until it reaches an angle of repose, the chamber is then raised further to release more crop. Preferably, the chamber can also move horizontally for distribution of the product across the area of a wide container.

The chamber has first sensor means which detect when the level of the bulk product reaches a certain height and this can be used to control the lowering and raising of the chamber. It is preferable if the sensor is a remote sensor. For example, it could be an infrared or ultrasonic sensor.

In order to determine the lowest position of the chamber with respect to the receptacle, it is preferable if the apparatus further comprises a second sensor which detects how far away the chamber is from the floor of the receptacle.

In a third aspect, the present invention relates to a method of filling a receptacle with a bulk product, the method comprising the steps of:

- a transporting a bulk product to a base of a chamber;
- b decreasing the relative displacement between the chamber and a base of the receptacle;
- c releasing the product from said chamber; and
- d increasing the relative displacement between the chamber and the base of the receptacle as the receptacle fills with product.

In order to minimise the distance dropped, it is preferable if the steps of adding the bulk product to the chamber and lowering the chamber are performed repeatedly. Alternatively, these two steps could be performed simultaneously.

The present invention may be used with a wide range of receptacles. For example, boxes, bags, big bags, lorries, storage silos and bins.

The present invention will now be described with reference to the following example in which:

Figure 1 shows apparatus in accordance with the present invention wherein the chamber is being filled;

Figure 2 shows the apparatus of Figure 1 when the floor of the chamber is being opened;

Figure 3 shows the apparatus of Figure 1 wherein the chamber has been raised; and

Figure 4 shows the apparatus of Figure 1 with the chamber at its highest position.

Figure 1 shows a receptacle 1 which is to be filled by bulk product 3 such as potatoes. The filling apparatus has a vertically extending chamber 5 which is open on three sides and has a side 7 which is open above the level of a conveyor belt 9. Conveyor belt 9 delivers crop into the chamber 5. Conveyor belt 9 runs continuously.

The open side 7 of the chamber is closed below the level of the conveyor belt 9 by a variable height side wall formed by belt 11 which extends under the conveyor belt 9. Belt 11 is fixed to the bottom corners of the front and back walls 12 of the chamber 5 and runs around a guide 13 which holds the belt 11 against the edges of the front and back walls 12. The other end of the belt 11 is rolled around a drum 17 which can feed out and pull in the belt 11 to lower and raise chamber 5. The weight of the chamber and product keeps the belt in tension to prevent the product spilling out the side. The chamber 5 runs between vertical guides, not shown.

The floor of chamber 5 is provided by base belt 21. The base belt 21 is attached to the chamber 5 at the bottom edge 25 of the other side wall 26 and returns around a roller 28 which moves across the floor of the chamber to open and close the base of the chamber. The belt 21 is held in tension by a roller 30. The use of a retractable belt reduces any abrasion of the product when the door is opened. Other door arrangements could be used.

As the product is fed into the raised chamber by the conveyor 9, the chamber 5 is lowered into receptacle 1 by unrolling belt 11 from drum 17 under the control of a sensor 31 which senses the proximity of the product 3. The chamber is lowered a small amount when sensor 31 detects the proximity of the product 3.

A sensor 37 on the chamber 5 indicates when the chamber 5 is close to the bottom of the receptacle 1. After the signal from this sensor is received, the next signal from the first sensor 31 opens the floor of the chamber 5.

Figure 2 shows the chamber 5 at its lowermost position, and retractable chamber floor 21 in the process of being opened. It is fully opened at this lowest position of the chamber 7. It can be seen that the bulk material 3 falls a small distance and hence is fed at a low velocity. As the product 3 is

released from chamber 5, a repose level will be reached, where no more product 3 can spill out of the chamber 5. At this point, the chamber, which is still being filled by the conveyor 9, will fill to a level detected by sensor 31 and the chamber is raised a small amount on the signal from sensor 31, by rolling in belt 11.

Figure 3 shows an intermediate level, with more bulk product 3 spilled-out of the chamber 5 into the receptacle 1. At each stage, the product 3 in the receptacle 1 reaches a level of repose such that no more product 3 can flow out of the chamber 5 and the chamber 5 fills to a level detected by the sensor 31.

Figure 4, shows the final position where the chamber 5 is fully raised. This is detected by another sensor. The conveyor belt 9 is stopped, or reversed if a double ended filling machine is being used. Any residue of product in the chamber 5 falls into the receptacle 1 as it is removed. The door 21 is then closed, ready to begin the next filling cycle when a receptacle is placed in position under the chamber 5.

**CLAIMS:**

1. A filling apparatus for filling a receptacle with a bulk product, the apparatus comprising a chamber for receiving the bulk product therein; transport means for transporting the bulk product to a base of the chamber; and moving means for effecting relative movement between said chamber with respect to both the receptacle and the transport means such that, as the chamber fills with the bulk product, the relative displacement between the chamber and a base of the receptacle is reduced.
2. A filling apparatus according to claim 1, wherein the chamber includes an openable floor.
3. A filling apparatus according to claim 2, wherein said openable floor is a retractable floor.
4. A filling apparatus according to claim 3, wherein the retractable floor comprises a first belt and a roller.
5. A filling apparatus according to claim 4, wherein the first belt is fixed at a side of the chamber and the roller is movable between the said side and an opposing side of the chamber.
6. A filling apparatus according to any preceding claim, wherein the chamber comprises a first side wall, wherein the height of said first side wall can be varied.
7. A filling apparatus according to claim 6, wherein the transport means are provided on the same side of the chamber as that of the first side wall.

8. A filling apparatus according to either of claims 6 or 7, wherein the first side wall of the chamber is provided by a second belt which is fixed at one end to the base of the chamber.
9. A filling apparatus according to claim 8, wherein the moving means comprises pulling means for pulling-in or letting-out the first belt.
10. A filling apparatus according to claim 9, wherein the pulling means comprises a drum which is attached to one end of the first belt, the first belt being pulled-in by rotating the drum.
11. A filling apparatus according to any preceding claim, wherein the transport means is a conveyor belt.
12. A filling apparatus according to any preceding claim, wherein the filling apparatus further comprises a first sensor for detecting when the level of bulk product in the chamber is approaching a predetermined maximum level.
13. A filling apparatus according to claim 12, wherein the first sensor is a remote sensor.
14. A filling apparatus according to any preceding claim, wherein the apparatus further comprises a second sensor for detecting when the base of the chamber is at a predetermined distance from the base of the receptacle.
15. A filling apparatus according to any preceding claim, wherein the apparatus further comprises means for moving the chamber in a horizontal direction.

16. A filling apparatus according to any preceding claim wherein the inside of sidewalls of the chamber are soft covered.

17. Apparatus for filling a box with a crop, the apparatus comprising a chamber having a base which is vertically moveable into and out of the box, a conveyor belt for delivering the crop into the chamber, the crop being supported on the base and the base of the chamber being lowered into the box and relative to the conveyor belt as the chamber fills with crop and the base being retractable to release crop into the box from the bottom of the chamber.

18. A method for filling a receptacle with a bulk product, the method comprising the steps of :

- a transporting a bulk product to a base of a chamber;
- b decreasing the relative displacement between the chamber and a base of the receptacle;
- c releasing the product from a base of said chamber; and
- d increasing the relative displacement between the chamber and the base of the receptacle as the receptacle fills with the product.

19. A method of filling a receptacle according to claim 18, wherein the method comprises repeating steps a and b a plurality of times before proceeding to steps c and d.

20. A method according to either of claims 18 or 19, wherein the chamber comprises an openable floor and step c comprises opening the floor of the chamber.

21. A method according to claim 20, wherein the floor of the chamber is open during step d.

22. A method according to any of claims 18 to 21, further comprising moving the chamber in a horizontal direction.
23. An apparatus for filling a receptacle with a bulk product as hereinbefore described with reference to the accompanying drawings.
24. A method of filling a receptacle with a bulk product as herein before described with reference to the accompanying drawings.



Application No: GB 9723203.7  
Claims searched: 1-24

Examiner: Andrew Glanfield  
Date of search: 27 November 1998

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.P): B8E, B8S (SAK, SAL, SAN, SAP, SAQ, SAR, SCA)

Int CI (Ed.6): B65G (47/18, 47/19, 47/20, 65/30, 65/32, 65/34, 65/40, 69/16)

Other: -

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
X	GB 476343 (INTERNATIONAL COMBUSTION a) see especially figure 1.	1-3, 6, 7, 14-17
X	GB 459899 (INTERNATIONAL COMBUSTION b) see embodiment as shown in figures 4-5.	1-3, 11, 14-17
X	US 5016686 (ATLANTIC RICHFIELD) see figure 1.	1-3, 6, 7, 11-22
X	US 4250690 (KOSAN) see figures 1 and 2.	1-3, 11-17

X Document indicating lack of novelty or inventive step  
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